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PROVINCE OF ALBERTA
DEPARTMENT OF EDUCATION

# CURRICULUM GUIDE

FOR

# SENIOR HIGH SCHOOL SCIENCE

INCLUDING SCIENCE 10, SCIENCE 20,
CHEMISTRY 30 AND PHYSICS 30
SCIENCE 11, 22 AND PHYSICS 32

September, 1966

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### MEMBERS OF THE SENIOR HIGH SCHOOL CURRICULUM COMMITTEE:

M. L. Watts, Director of Curriculum, Chairman
J. B. Bell, High School Inspector, Red Deer
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G. S. Grant, Medicine Hat
L. G. Hall, High School Inspector
Mrs. D. A. Hansen, ASTA, Calgary
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J. W. James, Superintendent of Secondary Schools, Calgary School Board
L. W. Kunelius, High School Inspector, Calgary
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W. Moysa, ATA, Edmonton
Dr. J. R. Nursall, Department of Zoology, University of Alberta, Edmonton
Dr. S. N. Odynak, High School Inspector, Calgary
R. C. Ohlsen, High School Inspector
Dr. R. E. Rees, Director of Special Services
J. F. Swan, High School Inspector
N. J. Andruski, A/Assistant Director of Curriculum, Secretary

### MEMBERS OF THE PHYSICAL SCIENCE SUBCOMMITTEE:

N. J. Andruski, A/Assistant Director of Curriculum
G. Caron, Sr. High School Consultant, Calgary School Board
J. C. Charyk, Hanna
Dr. S. G. Davis, Department of Chemistry, University of Alberta, Edmonton
Leonard Hanak, Edmonton
G. Hooper, Bawlf
T. Mitsunaga, Lethbridge
William Moysa, Edmonton
Dr. Marshal Nay, Associate Professor, Faculty of Education, University of Alberta, Edmonton
Dr. S. B. Woods, Department of Physics, University of Alberta, Edmonton

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## OBJECTIVES FOR COURSES IN SCIENCE

**Students should:**

1. Acquire facts, principles, and concepts in order to understand and interpret their environment.
2. Acquire some competence in critical thinking, and appreciation of scientific inquiry.
3. Develop a scientific attitude.
4. Gain some skill in the reading and analysis of current articles on scientific subjects.

## GENERAL OBSERVATIONS CONCERNING THE TEACHING OF SCIENCE

1. Experimental work is to be considered an integral part of each course.
2. All lessons should stress and illustrate scientific inquiry. Conclusions should be based on actual observations wherever possible.
3. In demonstrations and student experimental work emphasis should be on the scientific principles.
4. Teaching aids (films, pictures, models, etc.) should be used freely. See the reference list at the end of the guide.
5. Constant review such as the short test is valuable. New concepts should be related, where possible, to previous work covered.
6. The vocabulary of science should be emphasized.
7. Safety should be stressed at all times. (See below.)

## SAFETY AND MAINTENANCE OF THE SCIENCE LABORATORY

1. Teachers should become aware of potentially dangerous experiments and demonstrations planned in their program and take adequate steps to prevent an accident.
2. Students should be made aware of potentially dangerous activities in doing experiments, and should understand and be made to follow directions.
3. Chemicals should be stored in a neat and orderly manner, and should be arranged alphabetically.
4. Care should be taken in storing chemicals, e.g. the kerosene level on sodium and the water level on phosphorus should be checked. Metallic equipment should not be stored near chemicals which may cause their corrosion.
5. All laboratory activities should be supervised. Students should be taught how to use and care for laboratory equipment. All equipment should be cleaned before being put away.
6. All apparatus should be in good repair. Irreparable equipment should be discarded. In particular, chipped glassware can be dangerous.
7. The science teacher should see that chemicals and equipment are ordered and available as required. A Spring inventory or a continuing record of impending shortages will be helpful in making up order lists.
8. Safety equipment (fire extinguishers, asbestos blankets, eye washers, etc.) should be provided in each science laboratory and should be readily accessible. Students should be instructed in the proper use of this equipment.
9. A first-aid kit should be available.

# SCIENCE 10

This course is offered in two sections, one-half year of chemistry and one-half year of physics.
*Note that alternative programs are available for the chemistry section of this course.*

Because of the numbers of students who transfer during the year, the chemistry section of the course should be taught first. In large schools where the number of classes make it desirable to offer both the chemistry and physics sections simultaneously to different classes, transfer presents no problems.

## TEXTS

*Chemistry, An Experimental Science* (CHEM Study)
*Introductory Chemistry and Physics*, Pickard and Radomsky
*Laboratory Manual to accompany Chemistry, An Experimental Science*

## REFERENCES

*Atoms, Crystals and Molecules*, by A. H. Drummond Jr., (American Education Publications, Education Center, Columbus 16, Ohio, U.S.A.) (Paper-bound)
*Chemistry, A Modern Approach* by Smoot, Price and Barrett, (Charles E. Merrill Publishing Co., Columbus, Ohio.)
*Teacher's Guide to accompany Chemistry, an Experimental Science.*

## CHEMISTRY SECTION

**Alternative I:** *Introductory Chemistry and Physics*, Pickard and Radomsky.
Teachers using this text should modify their presentation of atomic structure and include the mole concept.

Chapter 1: Our Debt to the Past
Chapter 2: Matter: Its Classification
Chapter 3: Matter: Its Composition
Chapter 4: Matter: Its Structure
Chapter 5: Symbols and Formulae: The Shorthand of Chemistry
Chapter 6: Chemical Equations: Short Stories of Reactions
Chapter 7: Oxygen: The World's Most Abundant Element
Chapter 8: Hydrochloric Acid: A Typical Acid
Chapter 9: Sodium Hydroxide: A Typical Base
Chapter 10: Sodium Chloride: A Typical Salt

**Alternative II:** *Chemistry, An Experimental Science (CHEM STUDY)*

Chapter 1: Chemistry: An Experimental Science
Chapter 2: A Scientific Model: The Atomic Theory
Chapter 3: Chemical Reactions
Chapter 4: The Gas Phase: Kinetic Theory
Chapter 5: Liquids and Solids: Condensed Phases of Matter
Chapter 6: Structure of the Atom and the Periodic Table
Experiments I - II from Laboratory Manual to accompany *Chemistry, An Experimental Science.*

## NOTES TO TEACHERS

1. The following materials are available to teachers offering the CHEM Study program:
   (a) *Teachers' Guide for Chemistry, An Experimental Science* (available from the School Book Branch.)
   (b) Programmed instruction pamphlets: Slide Rule and Exponential Notation
   (c) Achievement Tests: These are available as chapter, semester and final examinations. Batteries of these tests are published for 1963 - 64, 1964 - 65 and 1965 - 66.
   Items (b) and (c) are available from W. H. Freeman Company, 660 Market Street, San Francisco 94104.
   (d) Films:
      1. Gases and How They Combine (Chapter 3)
      2. Gas Pressures and Molecular Collisions (Chapter 4)
      3. Chemical Families (Chapter 5) are considered useful aids in teaching the chapters indicated.
   These films are available from the following sources:
      1. Audio-Visual Services Branch, Department of Education
      2. Department of Extension, University of Alberta, Edmonton
      3. Modern Learning Aids — 1875 Leslie Street, Don Mills, Ontario
2. In addition to the information in the Teacher's Guide, the following suggestions have been made by Alberta teachers offering the course:
   (a) The first three chapters are introductory material and should be covered rapidly. Succeeding chapters will provide review of these chapters. Suggested time 4 to 4½ weeks.

(b) Spend only sufficient time on "uncertainty" to enable students to become acquainted with mechanics of it (2 days). The programmed pamphlet "Exponential Notations" is useful.
(c) Do not introduce use of significant figures until Chapter 4. The above program is also useful for developing this topic.
(d) Beginning with Chapter 4 of this course it may be helpful to the slower students to provide them with supplementary problems from other texts before attempting questions in the CHEM study text.

## PHYSICS SECTION

### TEXT

*Introductory Chemistry and Physics*, Pickard and Radomosky

Chapter 11: Molecular Forces in Liquids (Optional)
Chapter 12: Pressure in Liquids at Rest
Chapter 13: Pressure in Gases
Chapter 14: Fluids in Motion
Chapter 15: Experiments in the Mechanics of Fluids (Optional, except experiment 13)
Chapter 16: Heat and Temperature
Chapter 17: Expansion of Solids
Chapter 18: Expansion of Liquids
Chapter 19: Expansion of Gases
Chapter 20: Specific Heat and Thermal Capacity
Chapter 21: Latent Heat
Chapter 22: Experiments on Heat
Chapter 23: Production, Propagation, and Velocity of Sound
Chapter 24: Transmission of Sound
Chapter 25: Distinguishing Features of Sound
Chapter 26: Resonance: Sympathetic Vibrations
Chapter 27: Laws of Stretched Strings
Chapter 28: Experiments on Sound

### CHEMISTRY EQUIPMENT Science 10

FOR ALTERNATIVE I: *Introductory Chemistry & Physics*, Pickard and Radomsky

Apparatus (for a group of two)
Beakers 2 - 150 ml. capacity
1 - 250 ml. capacity
1 mortar and pestle (small size)
1 Florence flask (500cc)
1 deflagrating spoon
1 doz. test tubes (medium size, Pyrex)
2 test tube clamps
3 crucibles and covers (size "0")
2 four-inch wire gauge (asbestos)
1 crucible tongs
2 evaporating dishes
1 Bunsen burner
1 Erlenmeyer flask (500 ml.)
2 rubber tube clamps
1 graduated cylinder (50 ml.)
1 test tube brush
1 set of ring stand and rings
1 funnel (small)
2 utility clamps
1 wire triangle (clay guards)
3 wide mouth gas bottles
1 four-inch triangular file
1 wing top for Bunsen burner
1 spatula (small)
1 asbestos mat (12" square)
1 thermometer (-12 to 110°C)
1 pneumatic trough
6 reagent bottles (4 oz. size — named for chemical reagents, glass stoppers)

NOTE: The following equipment and materials are also required: Balances, glass and rubber tubing, rubber stoppers, beakers, gas generators, graduated cylinders, filter paper, litmus paper, distilled water, Crookes tube and induction coil, pith balls, rods, fur and silk cloth.

### REAGENTS AND MATERIALS REQUIRED (based on a group of twenty students)

| | Quantity |
|---|---|
| Alcohol, Methyl (local purchase) | 1 gal. |
| Aluminum, sheet | 1 sq. ft. 1/32 inch thick |
| Ammonium hydroxide | 4 lbs. |
| Barium Chloride, xtals CP. | 1 lb. |
| Barium Chloride, Tech. | 1 lb. |
| Calcium Carbonate (marble chips) | 5 lbs. |
| Calcium Chloride, Gran USP. | 5 lbs. |
| Copper, sheet (for strips) | 1 lb. 1/32 inch thick |
| Copper Sulphate, xtals CP. | 1 lb. |
| Cupric Chloride, anhyrous | ¼ lb. |
| Hydrochloric Acid, concentrated Sp. G 1.19 | 6 lbs. |
| Iron filings | 1 lb. |
| Iron nails (obtain locally) | |
| Lead, Sheet | 1 sq. ft. 1/16 inch thick |
| Lemon juice (local purchase) | |
| Litmus | 4 ozs. |
| Manganese Dioxide CP. | 3 lbs. |

| | |
|---|---|
| Magnesium ribbon | 1 oz. |
| Mercuric Oxide CP. | ¼ lb. |
| Methyl Orange | 1 oz. |
| Nitric Acid USP | 7 lbs. |
| Phenolphthalein | 4 ozs. |
| Potassium Chloride | 1 lb. |
| Potassium Chlorate CP. | 2 lbs. |
| Salt (not iodized) Granular USP | |
| Sand (local purchase) | 5 lbs. |
| Silver Nitrate | |
| Sodium Hydroxide, pellets USP | 1 lb. |
| Sodium, metal | ¼ lb. |
| Sodium Sulphate, xtals CP. | 1 lb. |
| Solder, spool (local purchase) | |
| Sugar, cubes (local purchase) | |
| Sulphur (flowers of S.) powdered | 1 lb. |
| Sulphuric Acid, SP. G. 1.83 | 9 lbs. |
| Vinegar (local purchase) | |
| Zinc (Mossy) (low in As, Fe and Pb) | 1 lb. |

CP—Highest degree of purity. USP—Less Pure Tech—Contains some impurities

**FOR ALTERNATIVE II:** *Chemistry, An Experimental Science*

The quantities suggested in this list are based on the assumption that, in the main, each student in a class of 30 may carry on individual experiments.

**Equipment**

| | |
|---|---|
| Absolute zero demonstrator | 1 |
| Needle valve or regulator | 1 |

**Glass Equipment**

| | |
|---|---|
| Beakers, 2 liter | 3 |
| Beakers, 400 ml. | 30 |
| Beakers, 250 ml. | 30 |
| Beakers, 100 ml. | 30 |
| Burrette (50 ml.) | 30 |
| or | |
| Gas measuring tube | |
| Erlenmeyer flasks, 250 ml. | 3 |
| Pipette, 1 ml. graduated | 30 |
| Test tubes, 18 x 150 mm. | 60 |
| Test tubes, 13 x 100 mm. | 150 |
| Vial shell form 15 x 45 mm. | 30 |
| Watch glass, 75 mm. diam. | 30 |

**Hardware**

| | |
|---|---|
| Burrette brush | 5 |
| Burner | 30 |
| Clamp, utility | 30 |
| Funnel rack | 15 |
| Meter rulers | 15 |
| Pinch or screw clamp | 30 |
| Ring stand 18" | 30 |
| Ring support 4" | 30 |
| Rubber tubing ¼ or 3/16" | 60 feet |
| Squeeze bottles, 250 ml. | 30 |
| Stopper, cork no. 3 | 30 |
| Stopper, 1 hole, No. 0 or 00 | 30 |
| Stopper, 1 hole, rubber No. 6 | 30 |
| Stopper, 2 hole, No. 6 | 30 |
| Test tube brush | 30 |
| Test tube holder | 30 |
| Test tube rack | 30 |
| Thermometer — 10° to 110°C | 30 |
| Water trough (pneumatic) | 15 |
| Water reservoir, 6" deep | 15 |
| Wire gauge, 5 x 5" asbestos centre | 30 |

**Class Equipment**

| | |
|---|---|
| Balance, centigram | 15 |
| Balance, platform | 2 |
| Barometer | 1 |
| Conductivity apparatus | 1 |
| Neon glow bulb | |
| Lamp, 10 watt | |
| Lamp, 40 watt | |
| Funnel, 75 mm diam. | 30 |
| Funnel, separatory | 3 |
| Glass plates (10 x 10 cm) | 30 |
| Glass stirring rod 6 mm | 30 |
| Glass tubing, 6 mm 4 ft. long | 30 |
| Graduate, 10 ml. | 30 |
| Graduate, 25 ml. | 30 |
| Graduate, 100 ml. | 30 |
| Jar, ½ gal. or Winchester | 3 |
| Medicine droppers | 30 |

## Chemicals

| | |
|---|---|
| Acetone or amyl alcohol | 1 Litre |
| $ALCL_36H_20$ | 6 gm. |
| $AL_2(SO_4)_318H_20$ | 14 gm. |
| $BaCL_22H_20$ | 20 gm. |
| $Ba(NO_3)_2$ | 10 gm. |
| Benzene | 150 ml. |
| $Ca(OH)_2$ | 100 gm. |
| $CoCl_26H_20$ | 10 gm. |
| $Co(NO_3)_2.6H_20$ | 10 gm. |
| Copper wire, 16 gauge | 1 lb. |
| Paradichlorobenzene | 300 gm. |
| Ethanol | 500 ml. |
| $FeCl_36H_20$ | 10 gm. |
| Lead sheet 1/32" thick | 500 $cm^2$ |
| $Pb(NO_3)_2$ | 120 gm. |
| Methanol | 150 ml. |
| $HNO_3$ Cone | 2 Litres |
| Oxygen (bottled) | |
| Paraffin (household) | 150 gm. |
| KCl | 5 gm. |
| $K_2C_2O_4$ | 10 gm. |
| KOH | 10 gm. |
| AgCl | 10 gm. |
| $AgNO_3$ | 150 gm. |
| NaCl | 50 gm. |
| $Na_2CrO_4$ | 5 gm. |
| NaOH | 50 gm. |
| NaI | 60 gm. |
| $NaNO_3$ | 5 gm. |
| $Na_2SO_4$ (anhyd.) | 10 gm. |
| $Sr(NO_3)_2$ | 10 gm. |
| Sugar | 10 gm. |
| Sulfur | 10 gm. |
| $H_2SO_4$ (conc) | 2 Litres |
| Tin (sheet or mossy) | 15 gm. |

## Miscellaneous

| | |
|---|---|
| Aluminum foil | 1 roll |
| Soup cans | 30 |
| Large fruit cans | 30 |
| 4" Lids | 30 |
| Candles (household) | 30 |
| Filter paper 11 cm. dia. | 60 sheets |
| Plastic bags, 1 quart | 30 |
| Steel wool No. 00 | 1/10 Lb. |

## Physics Equipment Science 10

1 Brownian movement apparatus
*1 set of Pascal Vases with base attachment
1 set of capillary tubes
1 barometer
*1 set of Magdeburg hemispheres
1 exhaust pump with base and bell jar
1 Torricellian tube
1 open tube manometer
1 Bourdon pressure gauge
1 lift pump model
1 Boyle's law apparatus
12 thistle tubes
1 Venturi tube
3 balance scales — (Harvard Trip)
3 sets of weights
5 glass U-tubes
5 lb. bottle methyl alcohol
5 lb. bottle carbon tetrachloride
5 lbs. mercury
5 thermometers (centrigrades)
5 calorimeters
2 coefficient of linear expansion apparatus with spherometer and rods
2 adhesion disks
1 adjustable thermostat
4 dilatometers
1 ball and ring (hand form)
1 bi-metalic strip
2 Charles' Law tubes (Waterman form)
2 boilers or steam generators
2 sets specific heat specimens
4 water traps (for heat of vaporization)
4 meter sticks
24 beakers
glass tubing
rubber delivery tube
rubber stoppers (6 lb. assorted)
4 graduated cylinders 100 cc
2 glass tube cutters
retort stands clamps & rings
12 bunsen burners or propane burners
2 sets of tuning forks (unmounted)
1 set of tuning forks (mounted)
2 rubber hammers
*1 Kundt's tube
*1 pint cork dust
1 steel rod
1 brass rod
1 coil spring (longitudinal vibrators)
1 electric bell in vacuo
1 rotator (hand driven, worm drive)
1 Savart's toothed wheels
1 Crova's disc
1 combined siren and color disc
1 sonometer with strings of varied densities and diameters
1 set of collision balls
2 sets of resonance tubes

*Optional equipment*

# SCIENCE 20

This course is offered in two sections; one-half year of chemistry and one-half year of physics.

Note that alternative programs are available for BOTH the chemistry and physics sections of this course.

The sequence of physics, the chemistry, is to be followed to reduce difficulties when students transfer during the year. This sequence is not mandatory in large schools where a number of classes of Science 20 are taught since transfers do not present a problem here.

**Physics Alternative I:**

*Physics for Secondary Schools,* Alberta Edition, Eubank, Ramsay, Pickard

**Physics Alternative II:**

*Physics (PSSC)*

**Chemistry Alternative I:**

*Chemistry An Experimental Science* (CHEM Study) — Laboratory Manual to accompany *Chemistry, An Experimental Science*

**Chemistry Alternative II:**

*The Elements of Chemistry* — Radomsky, Kass and Pickard

**References:**

See References under Chemistry 30 and Physics 30.

## PHYSICS SECTION

**Alternative I:** *Physics for Secondary Schools,* Alberta Edition, Eubank et al.

Chapter 1: Introduction

Chapter 2: Measurement

Chapter 3: Density and Specific Gravity

Chapter 4: Buoyancy

Chapter 5: Force, Work and Power

Chapter 6: Experiments on Mechanics

Chapter 7: Nature and Propagation of Light

Chapter 8: Photometry

Chapter 9: Reflection of Light — Mirrors

Chapter 10: Refraction of Light — Lenses

Chapter 11: Colour

Chapter 13: Experiments on Light

*Note to Teachers:* Appropriate experiments selected from the text should be performed by the students.

**Alternative II:** Physics (PSSC) 1st or 2nd Edition

| PSSC 20 - Using 1st Ed. of Textbook, Physics | PSSC 20 - Using 2nd Edition of Textbook, Physics |
|---|---|
| Part 1 — The Universe<br>Chapter 1 — What is Physics<br>Chapter 2 — Time and Measurement<br>Chapter 3 — Space and its Measures<br>Chapter 4 — Functions and Scaling<br>**Notes to teachers:**<br>1. Chapter 5, Motion Along a Path, has been deferred to Physics 30X.<br>2. Four to five weeks only should be allowed for coverage of Part 1.<br>3. Teaching for mastery of concepts of Part 1 is unnecessary since there is ample application of principles in later chapters.<br>4. Home, Desk, and Lab problems from the second edition of the text should be used to supplement problems from the first edition.<br>Experiments:<br>I — 1, 2, 3, 4 | Part 1 — The Universe<br>Chapter 1 — An Introduction to Physics<br>Chapter 2 — Time and Measurement<br>Chapter 3 — Space and its Measures<br>Chapter 4 — Functions and Scaling<br>**Notes to teachers:**<br>Notes 1, 2 3, for the first edition apply also for the second edition<br>Experiments:<br>I — 1, 2, 3, 4 |
| Part II — Optics and Waves<br>Chapter 11 — How Light Behaves<br>Chapter 12 — Reflection and Images<br>Chapter 13 — Refraction<br>Sec. 1 - 8, incl.<br>Omit "The Rainbow"<br>p. 222 - 3<br>Chapter 14 — Lenses<br>Sec. 1 - 3 incl.<br>omit sec. 4 - 7 incl.<br>Chapter 15 — The Particle Model of Light<br>Sec. 1 - 8 incl.<br>Chapter 16 — Introduction to Waves<br>Sec. 1 - 6 incl.<br>Chapter 17 — Waves and Light<br>Experiments:<br>II — 1, 2, 3, 4, 5, 7, 8, 9, 10, 11.<br>Omit Exp. II — 6 | Part II — Optics and Waves<br>Chapter 11 — How Light Behaves<br>Chapter 12 — Reflection and Images<br>Chapter 13 — Refraction<br>Sec. 1 - 11 incl.<br>(includes lenses;<br>omit "The Rainbow")<br>Chapter 14 — The Particle Model of Light<br>Sec. 1 - 8 incl.<br>Chapter 15 — Introduction to Waves<br>Sec. 1 - 6 incl.<br>Chapter 16 — Waves and Light<br>Experiments:<br>II — 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. |

## NOTES TO TEACHERS

1. Teachers' Resource Books and Guides are available for PSSC Physics. These include three kinds of information:

   (1) General discussion of the teaching of appropriate sections of the course.

   (2) Solutions to problems.

   (3) Laboratory suggestions.

   There are five parts to the Teacher's Resource Book and Guide for edition 1 of which parts 1, 2 and 5 are useful for Science 20 teachers. For edition 2 there are only four parts of which parts 1 and 2 are helpful. These publications are available through the School Book Branch.

2. A series of films has been produced to accompany the PSSC text. These are available from the Modern Learning Aids, (See p. 5) or from Audio Visual Services Branch, Department of Education, Edmonton.

3. A series of paperback books, *The Science Study Series* has been prepared by PSSC to provide supplementary material for Physics students. Reaction to this series has been quite favorable. They are published by Doubleday & Company Incorporated, Garden City, New York and are available through the School Book Branch on special order.

4. For information regarding necessary laboratory equipment for offering PSSC Physics, teachers should refer to page 23 of this guide.

## CHEMISTRY SECTION

**Alternative I:** *Chemistry, An Experimental Science* (CHEM Study)

Chapter 7: Energy Effects in Chemical Reactions

Chapter 8: The Rates of Chemical Reactions

Chapter 9: Equilibrium in Chemical Reactions

Chapter 10: Solubility Equilibria

Chapter 11: Aqueous Acids and Bases

Chapter 12: Oxidation - Reduction Reactions

Experiments 12 -21 from Laboratory Manual to accompany *Chemistry, an Experimental Science*

Note to Teachers: 1: See notes page dealing with CHEM Study in Science 10.

2. Films:

#4115 - Molecular Motions

#4121 - Introduction to Reaction Kinetics

#4124 - Equilibrium

#4130 - Acid Base Indicators

#4133 - Electrochemical cells

## LABORATORY REQUIREMENTS, for Science 20 (CHEM Study)

Note: Items marked (X) are also used in the Science 10 CHEM Study alternative.

| | Quantity | Description |
|---|---|---|
| *Equipment* (Item Price over $10.00) | | |
| (X) | 15 | Centigram balance, triple beam, metric, ohaus 311 |
| | 1 | Wall clock, sweep second hand |
| | 8 | D.C. Voltmeter, 1000 ohm/v. 0-10 volt |
| (X) | 30 | Beakers, 400 ml. |
| (X) | 30 | Beakers, 250 ml. |
| (X) | 30 | Beakers, 100 ml. |
| | 150 | Dropping bottles, 60 ml. |
| (X) | 30 | Flask, 250 ml. |
| (X) | 3 pkg. (3 dozen) | Stirring rods, 6 inch, 3/16" diameter |
| (X) | 30 | Graduated cylinders 10 ml. |
| (X) | 30 | Graduated cylinders 25 ml. |
| (X) | 30 | Graduated cylinders, 100 ml. |
| (X) | 3 pkg. (3 dozen) | Medicine droppers, straight type |
| | 120 | Test tubes, Pyrex glass 18 x 150 mm. |
| | 150 | Test tubes, Pyrex glass 13 x 100 mm. |
| | 150 | Vial, long form, shell |
| | 32 | Alligator clip |
| (X) | 30 | Burner, lab gas |
| (X) | 30 | Clamp, Utility |
| | 60 ft. | Copper connection wire rubber Covered B & S gauge 14 |
| | 16 | Porous cup |
| (X) | 30 | Clamp, Hoffman improved (or similar) |
| (X) | 30 | Support rod and base assembly 20" |
| (X) | 30 | Ring with clamp 4" diameter |
| | 30 | Washing bottles, polyetheleyne (dispensing) 4 oz. |
| | 30 | Washing bottles, polyethelyne 8 oz. |
| (X) | 1 bag of 100 | Corks #3 xx quality |
| (X) | 30 | Test tube brush, white nylon fan tip |
| (X) | 30 | Clamps, Stoddards (test tube holder) |
| (X) | 30 | Thermometer, centigrade - 10° to + 110° (1° subdivision) |
| (X) | 30 | Wire gauze, galv. iron, asbestos center 5" x 5" |
| | 5 pints (2 class supply) | Acetic acid, glacial reagent grade |

| | | |
|---|---|---|
| (X) | 2 pints | Acetone, pure |
| | 25 g. (250 class supply) | Alizarin yellow R. (powder) |
| | 1 pt. bottle | Ammonium hydroxide, reagent grade, conc. |
| | 1 lb. bottle | Ammonium chloride (reagent grade) |
| | 4 oz. bottle (100 class supply) | Ammonium dichromate, reagent grade |
| | 1 lb. (25 class supply) | Ammonium nitrate (pure) |
| (X) | 4 oz. (5 class supply) | Barium nitrate |
| | 4 oz. | Calcium carbonate (marble chips) |
| | 1 lb. (75 class supply | Calcium hydroxide, powder |
| | 1 lb. | Carbon tetrachloride, pure |
| | 1 | Chlorine gas (lecture cylinder, empty returnable for $7.00 credit) |
| | 4 oz. (100 class supply) | Citric acid, reagent grade |
| (X) | 1 lb. | Copper wire #16 |
| | 1 lb. | Copper metal sheet .005 in. |
| | 4 oz. | Copper (II) nitrate, reagent grade |
| (X) | 1 qt. | Ethanol, denatured |
| (X) | 4 oz. (2 class supply) | Ferric chloride, reagent grade |
| | 4 oz. | Ferric nitrate, reagent grade |
| | 4 oz. (10 class supply) | Ferrous sulphate, reagent grade |
| | 6 lb. | Hydrochloric acid, conc. reagent grade |
| | 10 g. (40 class supply) | Indigo carmine, certified |
| | 1 oz. | Iodine, reagent grade |
| | 1 lb. | Lead sheet 1/32 in. |
| | 4 oz. (3 class supply) | Lead dioxide |
| (X) | 1 lb. | Lead nitrate, reagent grade |
| | 4 oz. (10 class supply) | Magnesium oxide, reagent grade |
| | 4 oz. (3 class supply) | Manganese sulphate, reagent grade |
| | 4 oz. | Manganese dioxide |
| | 1 oz. (25 class supply) | Methyl Orange, reagent grade |
| (X) | 1 lb. | Nitric Acid, conc., R.G. |
| | 25 g. (250 class supply) | Orange IV indicator |
| | 4 oz. (100 class supply) | Oxalic acid pure |
| | 1 oz. (10 class supply) | Phenolphthalein, powder, pure |
| | 4 oz. (35 class supply) | Potassium bromide, R.G. |
| (X) | 4 oz. (2 class supply) | Potassium chromate, R.G. |
| | 1 lb. | Potassium dichromate, R.G. |
| | 4 oz. (5 class supply) | Potassium acid phthalate, R.G. |
| | 4 oz. (5 class supply) | Potassium acid tartrate, R.G. |
| | 1 lb. | Potassium hydroxide, pellets, R.G. |
| | 4 oz. (2 class supply) | Potassium iodate, R.G. |
| | 4 oz. (50 class supply) | Potassium permanganate, R.G. |
| | 4 oz. (100 class supply) | Potassium thiocyante, R.G. |
| | 2 sheets (3 oz.) | Silver metal foil (B & S 20) 60 $cm^2$ per sheet |
| | 1 oz. | Silver acetate, R.G. |

| | | |
|---|---|---|
| (X) | 1 lb. (3 class supply) | Silver nitrate, R.G. |
| | 4 oz. (3 class supply) | Sodium acetate, R.G. |
| | 4 oz. | Sodium bromide |
| | 1 lb. (6 class supply) | Sodium carbonate, R.G., anhydrous |
| (X) | 1 lb. (4 class supply) | Sodium chloride, pure |
| | 1 lb. (400 class supply) | Sodium hydrogen carbonate, R.G. |
| | 1 lb. | Sodium hydroxide, R.G. pellets |
| (X) | 4 oz. (2 class supply) | Sodium iodide, R.G. |
| | 1 lb. | Sodium metabisulfite, R.G. |
| | 4 oz. (50 class supply) | Sodium phosphate (dibasic) |
| | 4 oz. (10 class supply) | Sodium oxalate, powder, R.G. |
| | 4 oz. (20 class supply) | Sodium phosphate, tribasic R.G. |
| | 4 oz. (3 class supply) | Sodium sulfide, R.G. |
| | 1 lb. (50 class supply) | Sodium sulfite, anhydrous, pure |
| | 1 lb. (75 class supply) | Starch, corn |
| (X) | 9 lbs. | Sulfuric acid, conc., R.G. |
| | 1 lb. | Zinc sheet (920 $cm^2$) |
| | 4 oz. | Zinc nitrate, R.G. |
| (X) | 1 | Conductivity apparatus (commercial type) |

plus

| | | |
|---|---|---|
| (X) | 1 | Attachment plug, screw type |
| | 2 sheets | Emery cloth, fine, 12" x 3" |
| (X) | 2 | Male sockets, screw in |
| (X) | 1 | Neon glow bulb |
| (X) | 1 | Lamp 15W, 115V |
| (X) | 1 | Lamp 40W, 115V |
| | 12 vials | Litmus paper, blue |
| | 12 vials | Litmus paper, red |
| | 1 box | Labels, size 2004 |
| | 1 pkg. | Rubber bands, small |
| | 1 lb. | Steel wool |
| | 1 bundle | Wood splints |

Alternative II: *Elements of Chemistry* by Radomsky, Kass and Pickard

References: See references under Chemistry 30, page 16.

UNIT I — ATOMS

Chapter 1 —The Fundamental Particles

Chapter 2 —The Structure of the Atom

Chapter 3 —The Periodic Classification of Elements

UNIT II — IONS AND MOLECULES

CHEMICAL BONDS (Omit section c (ii), c(iii) under molecular shape)

Chapter 5 —Naming of Compounds

Chapter 6 —Formula, Weights and Volumes

UNIT III — CHEMICAL REACTIONS

Chapter 8 —The Chemical Equation

Chapter 9 —Solutions

Chapter 10 —The Alkali Metals
Chapter 11 —The Halogens

} These chapters should be discussed along with Chapters 1, 2 and 3.

Experiments:

The following experiments contained in Chapters 7 and 12 of the text are to be undertaken as part of this course in chemistry:

Chapter 7 Experiments on Unit I and II

1 Models of atoms

2 Models of molecules

4 Size of molecules (suggested)

5 Conservation of matter

6 Definite composition

9 Boyle's law

10 Charles' law

Chapter 12 —Experiments on Unit III

1 Activity of metals

3 Ionization and colors of ions (teacher or class display)

5 Acids, bases, and salts (OMIT generation of hydrogen)

6 Titration

7 Hydrolysis

8 Flame tests for alkali metals

9 Preparation of HCl (OMIT or provide a teacher demonstration)

10 Tests for halogens

12 Preparation of $Cl_2$, $Br_2$ and $I_2$ (OMIT or provide as a teacher demonstration)

# CHEMISTRY 30

*Chemistry* (Canadian Edition), Sienko and Plane

*Laboratory Investigations in Chemistry*, Davis and Allen

## REFERENCES

*Teacher's Guide to Laboratory Investigations in Chemistry*, Davis and Allen (School Book Branch)

*Chemistry, A Modern Course*, Smoot, Price and Barrett, (Charles E. Merrill Publishing Co.)

*Instructor's Manual to accompany Chemistry*, Sienko and Plane, (McGraw-Hill Book Company Inc.)

*Study Guide for Sineko and Plane, Chemistry*, J. B. Russel (McGraw-Hill)

*Chemistry "An Experimental Science"*, Chemical Education Material Study, (W. H. Freeman and Company)

*Chemistry "An Experimental Science"*, CHEM, Teacher's Guide, (W. H. Freeman and Company).

*Chemistry "An Experimental Science"*, CHEM, Laboratory Manual, (W. H. Freeman and Company)

*Chemistry*, Choppin and Jaffe (W. J. Gage Ltd.)

*Chemistry, Principles and Concepts*, Sturchis, Nechamkin and Dorfaman (Prentice Hall)

*Teaching Chemistry with Models*, Sanderson (Van Nostrand)

*Chemical Bonding*, Companion (McGraw-Hill)

*Electronic Structure, Properties and the Periodic Laws*, Harry H. Sisler, Reinhold College Textbook Dept. (Paperbound)

*Chemical Systems*, Chemical Bond Approach Project, Webster (McGraw-Hill) Publishing.

*Atoms, Crystals, Molecules*, A. H. Drummond Jr., (American Education Publications, Education Centre, COLUMBUS 16, Ohio, U.S.A. (Paper-bound)

*Basic Modern Chemistry*, Madras, Hall and Holcomb (McGraw-Hill)

*General Chemistry*, T. L. Brown, (Charles E. Merrill Books Inc.)

*Chemical Bonding and the Geometry of Molecules*, Ryschkewitsch, (Reinhold) (Paperbound)

*Acids, Bases and the Chemistry of the Covalent Bond*, Calvin A. Vander Werf, (Reinhold) (Paperbound)

## COURSE CONTENT

| | |
|---|---|
| 1. Nature of Matter | (Chapter 2) |
| 2. Atoms | (Chapter 3) |
| 3. Chemical Bond | (Chapter 4) |
| 4. Stoichiometry | (Chapter 5) |
| 5. Gases | (Chapter 6, omitting equation of state, pages 149 and 150 and sections 15 and 16) |
| 6. Liquids | (Chapter 7) |
| 7. Solids | (Chapter 8, omitting sections 2, 3, and 5) |
| 8. Solutions | (Chapter 10, omitting sections 2 (Except Molarity and Normality) 3, 5, 6, 11 and 13: also omit Bronsted - Lowry and Lewis Acid Theories, page 214) |
| 9. Electrochemistry | (Chapter 14) |
| 10. Group IV Elements | (Chapter 24, omitting sections 3, 5, 6, 7, 8, and 9) |
| 11. Organic Chemistry | (Chapter 28, omitting sections 3, 4, and 5) |

Laboratory experiments for Chemistry 30 shall consist of the following experiments from *Laboratory Investigations in Chemistry*, Davis and Allen

Experiments 1, 2, 4, 8, 9, 10, 11, 12, 13, 15, 17, 20, 25, 26, 27, and 28.

## Cross Reference for Laboratory Investigations and Chemistry by Sienko and Plane

The following chart was designed as a guide to teachers to indicate when experimental work might best be carried forward in relation to the course content.

It should be noted that reference is made to experiments that are not included in the minimum list outlined above.

| Exp. No. | Topic | Sienko & Plane Section No. |
|---|---|---|
| 1. | Quantitative aspects of a chemical reaction) | |
| 2. | Effect of concentration on the density of a solution) | Introduction, 5:3 and 10:2 |
| 3. | Effect of concentration on rate and extent of reaction) | |
| 4. | The analysis of a salt. | 5:1 |
| 5. | The determination of a chemical equation and a chemical formula. | 2:2, 5:7 |
| 6. | A displacement reaction. | 5:4 |
| 7. | A quantitative study of a series of chemical reactions. | 5:4 |
| 8. | The spectra of elements. | 3:8 |
| 9. | A model deduced from experimentation. | 3:8 |
| 10. | Probability patterns. | 3:10 |
| 11. | Molecular models. | 4:7 |
| 12. | Heat of reaction - a neutralization. | 5:9 |
| 13. | Gas densities and molecular weights. | 6:9 |
| 14. | The formation and solution of crystals. | 8:1 |
| 15. | Lattice structures. | 8:3 |
| 16. | Electrical conductivity of solutions. | 10:4, 5 |
| 17. | Volumetric analysis. | 10:9 |
| 18. | A system in chemical equilibrium. | 13:8 |
| 19. | Oxidation reduction reactions. | 14:8 |
| 20. | Galvanic cells | 14:7 |
| 21. | A quantitative electrolysis. | 14:2 |
| 22. | Hydrogen ion concentration. | 17:6 |
| 23. | Some chemical reactions of the metal ions. | General, part II |
| 24. | Corrosion of iron. | 14:8 and 21:4 |
| 25. | Some organic reactions. | 28:1 |
| 26. | Development of a scheme of qualitative analysis. | General, part II |
| 27. | A qualitative analysis for some cations. | |
| 28. | To determine a procedure for the qualitative analysis of an anion unknown. | |

## Equipment List for Chemistry 30

This list is prepared on the basis of ideal conditions whereby each student carries on his own experiment.

### Per Student

| | |
|---|---|
| 6 | 13 mm test tubes |
| 4 | 18 mm test tubes |
| 1 | test tube holder |
| 2 | medicine droppers |
| 2 | 100 ml beakers |
| 1 | 250 ml beaker |
| 1 | Squeeze wash bottle |
| 1 | Y-tube |
| 1 | Ring stand |
| 1 | Pressure clamp |
| 1 | 100 ml graduate |
| 4 ft. | 6 mm glass tubing |
| 1 | 75 mm funnel |
| 1 | 75 mm watch glass |
| 1 | Bunsen burner |
| 1 | Clamp, utility |
| 1 | Bead wire |
| 1 | Stirring rod |
| 1 | 250 ml. erlenmeyer flask |
| 1 | Test tube brush |
| 1 | $10^0$ - $110^0$ C thermometer |
| 1 | 1 - hole no. 6 rubber stopper |
| 3 ft. | ¼ inch rubber tubing |
| 27 | 2 inch styrofoam spheres |
| 15 | 1 inch styrofoam spheres |
| 1 | Packet pipe cleaners |

### Per Class

| | |
|---|---|
| 1 | 250 ml. graduate |
| 1 | 1000 ml. volumetric |
| 1 | 0.1 gram platform balance |
| 2 | Neon glow bulbs, to fit standard light socket |
| 2 | 15 watt incandescent bulbs |
| 1 | Barometer |
| | Water bath (1 for 2 students) |
| | Atomic models (1 set for 4 students) |
| | 0.01 gram balance (1 for 4 students) |
| | Hand spectroscope (1 for 2 students) |
| | Jacks (100 for 4 students) |
| | Voltmeter (0-5v) (1 for 4 students) |
| | Copper wire, coated (2 ft. for 4) |
| | Alligator clamps (2 for 4 students) |
| | Burette brush (1 for 4 students) |

## Chemicals List for Chemistry 30 (for 30 Students)

| | |
|---|---|
| 500 gms. | $CuSO_45H_20$ |
| 2 Litres | $NH_4OH$ (conc. reag.) |
| 2 Litres | $H_2SO_4$ (conc. reag.) |
| 4 Litres | HCl (conc. reag.) |
| 2 Litres | $HNO_3$ (conc. reag.) |
| 100 Sheets | Filter paper, qualitative |
| 10 Grams | $Ca(NO_3)_2$ (or chloride) |
| 10 Grams | $Sr(NO_3)_2$ (or chloride) |
| 10 Grams | $Ba(NO_3)_2$ (or chloride) |
| 10 Grams | $KNO_3$ (or chloride) |
| 10 Grams | $Cu(NO_3)_2$ (or chloride) |
| 10 Grams | $LINO_3$ (or chloride) |
| 3 Lbs. | NaOH |
| 1 Cylinder | Oxygen (Note 4) |
| 1 Cylinder | $CO_2$ (or dry ice) (Note 5) |
| | stopcock grease for burette |
| 10 gms | $ZnSO_4$ |
| 100 gms | $AgNO_3$ |
| 100 gms | $Pb(NO_3)_2$ |
| 100 gms | $Al(NO_3)_3$ |
| 100 gms | $Cu(NO_3)_3$ |
| 100 gms | $FeSO_4.(NH_4)_2SO_4$ |
| 100 gms | $Fe(NO_3)_3$ |
| 100 gms | $Mg(NO_3)_2$ |
| 100 gms | $Ni(NO_3)_2$ |
| 5 Lbs. | NaCl (tech.) |
| 1 Lb. | NaCl (reagent grade) |
| 1 Lb. | $Zn(NO_3)_2$ |
| 2 Litres | Ethanol, denatured |
| 5 gms. | $K_3Fe(CN)_6$ |
| 5 gms. | $K_4Fe(CN)_6$ |
| 4 oz. | Agar Agar |
| 5 gms | Phenolphathalein |
| 300 gms | Cyclohexane |
| 300 gms | Cyclohexene |
| 1 pint | Benzene |
| 10 gms | $KNnO_4$ |
| 12 ml. | $Br_2$ Liquid Note 6 |
| 100 gms. | $CCl_4$ |
| 10 gms | $K_2Cr_20_7$ |
| 400 gms | 1 butanol (n-butyl alcohol) |
| 400 gms | 2 butanol (sec-butyl alcohol) |
| 400 gms | 2 methyl-2 propanol (tert. butyl alcohol) |

## Chemicals List for Chemistry 30 — Continued)

| | | | |
|---|---|---|---|
| 100 gms | Benzoic acid | 1 Lb. | Lead metal 1/100 inch foil |
| 100 gms | Methanol | 25 gms | Silver metal 1/100 inch foil |
| 10 gms | $Hg_2(NO_3)_2$ | 1 roll | Cu wire - 18 gauge |
| 10 gms | $Na_2CO_3$ | 100 gms | Potassium hydrogen phthalate |
| 10 gms | $Na_2SO_4$ | 30 | 1 quart plastic bags (obtain locally) |
| 10 gms | NaI | | |
| 1 Lb. | Zinc metal 1/100 inch foil | 30 sheets | 2 ft. x 2 ft. kraft or other paper |
| 2 Lbs. | Copper metal 1/100 inch foil | | |

## Notes to Teachers

1. Unless otherwise specified the salts may be hydrated.
2. Quantities listed allow for "normal" waste in the lab. Poor supervision can result in the use of several times the required amount.
3. Quantities listed do not correspond to commercial packages. For most chemicals the most economical size is the 1 lb. (or 500 g) bottle. Avoid larger sizes as wastage in use is greater, especially for deliquescent materials such or NaOH.
4. Oxygen may be obtained locally from a welding supply company. The amount required is 1 to 2 cubic feet. Alternatively a lecture demonstration bottle (with regulator) may be used.
5. Carbon dioxide may be obtained as dry ice or as bottled gas. The former is easily obtained but requires thought in its application.
6. Bromine comes as a liquid or in sealed capsules. Bottles are more convenient since it is difficult to reseal a capsule. Since $Br_2$ is a hazardous chemical, it may be more satisfactory to make up bromine water as required. (see Teachers' Guide for "*Chemistry, an Experimental Science*" p. 379 (Freeman, San Francisco, 1963).

# PHYSICS 30

Note that alternative programs are available.

## ALTERNATIVE I:

*Elementary Physics,* Littler

Laboratory Exercises in Physics 30

## ALTERNATIVE II:

*Physics (PSSC)*

Laboratory Guide for Physics (PSSC)

## REFERENCES:

*Physics,* (Teacher's Edition), Stollberg and Hill, (Houghton Mifflin)

*Modern Physics* (Teacher's Edition) Dull, Metcalfe and Williams, (Holt, Rinehart and Winston)

*Physics,* Taffel, (Allyn and Bacon)

*Foundations of Physics,* Lehrman and Swartz, (Holt, Rinehart, and Winston)

*The Science of Physics,* Beiser, Addison, (Wesley)

### ALTERNATIVE I — Elementary Physics, Littler

(a) The content selected from the text consists of materials on three topics: Mechanics, Heat and Electricity.

(b) The following portions of the text are used:

1. Mechanics: Chapters 1 - 9 inclusive
2. Review: Chapter 10 and 11
3. Heat: Review Chapters 13 - 18 inclusive and Chapter 21
4. Electricity: Chapters 33, 34, 36 up to and including "Solenoid", 37, 38 and 39

(c) In addition to the above it will be very desirable to commence the course by teaching the Metric System of measurement. (See Experiment 1, *Laboratory Exercises.)*

## DEMONSTRATIONS AND EXPERIMENTS

Both these devices should be regular procedures of teaching the course.

(a) Experiments:

The revised *Laboratory Exercises* consists of twenty experiments from which students are expected to perform.

Each of Experiments 1 - 11, inclusive, consists of two parts. In each case, Part B is stated as a follow-up problem to accompany PART A. PART B is provided as extra work for the better students; its use is optional and at the discretion of the teacher.

(b) Demonstrations:

In addition to the experiments described in *Laboratory Exercises,* the text provides ample suggestions for demonstrations.

## EQUIPMENT

A list of specific equipment needed for the prescribed experiments is contained in *Laboratory Exercises* in Physics 30.

## ALTERNATIVE II — PHYSICS (PSSC)

### Physics 30X - Using 1st Ed. of Textbook, *Physics*

Part 1 — The Universe

*Review — (Not more than 2 weeks)*

Chapter 2 — Time and Measurement
Sec. 4 and 7

Chapter 3 — Space and Its Measurement
Sec. 5 to 7 incl.

Chapter 4 — Functions and Scaling
Sec. 3 and 4

**New Work**

Chapter 5 — Motion Along A Path
Sec. 1 to 7 omitting 8

Chapter 6 — Vectors
Sec. 1 to 6 incl.

Exp. 1 — 5

Part III Mechanics

Chapter 20 — Newton's Law of Motion

Chapter 21 — Motion at the Earth's Surface
Sec 1 to 8 incl.

Chapter 22 — Universal Gravitation and the Solar System
Sec. 6 to 11, read 1 to 5

Chapter 23 — Momentum and Conservation of Momentum
Sec. 1 to 4, read 5 to 8

Chapter 24 — Work and Kinetic Energy
Sec. 1 to 8, 10 and 11

Chapter 25 — Potential Energy

Chapter 26 — Heat, Molecular Motion, Conservation of Energy

### Physics 30X - Using 2nd Ed. of Textbook, *Physics*

Part 1 — The Universe

*Review — (Not more than 2 weeks)*

Chapter 2 — Time and Measurement
Sec. 4 and 7

Chapter 3 — Space and Its Measurement
Sec. 5 to 7 incl.

Chapter 4 — Functions and Scaling
Sec. 3 and 4

**New Work**

Chapter 5 — Motion Along A Straight-Line Path
Sec. 1 to 8 incl.

Chapter 6 — Motion in Space
Sec. 1 to 7 incl.

Exp. 1 — 5

Part III — Mechanics

Chapter 19 — Newton's Law of Motion

Chapter 20 — Motion at the Earth's Surface
Sec. 1 to 8 incl.

Chapter 21 — Universal Gravitation and the Solar System
Sec. 6 to 11, read 1 to 5

Chapter 22 — Momentum and the Conservation Momentum
Sec. 1 to 4, read 5 to 7 and rockets

Chapter 23 — Work and Kinetic Energy
Sec. 1 to 8, 10 and 11

Chapter 24 — Potential Energy

Chapter 25 — Heat, Molecular Motion, Conservation of Energy

| Physics 30X — Using 1st Ed. | Physics 30X — Using 2nd Ed. |
|---|---|
| **Experiments:**<br>III — 2, 3, 4, 5, 6, (8), 9, 10, 11, 12, 13, 14<br>Part IV — Electricity and Atomic Structure<br>Chapter 27 — Some Qualitative Facts About Electricity<br>Chapter 28 — Coulomb's Law and the Elementary Electric Charge<br>Sec. 1 to 7 incl.<br>Chapter 29 — Energy and Motion of Charges in Electric Fields<br>Sec. 1 to 8, 13 and 14<br>Chapter 30 — The Magnetic Field<br>Chapter 31 — Electro-magnetic Induction and Electromagnetic Waves | **Experiments:**<br>III — 1, 2, 3, 4, 5, (7), 9, 10*, 11, 12, 13<br>Part IV — Electricity and Atomic Structure<br>Chapter 26 — Some Qualitative Facts About Electricity<br>Chapter 27 — Coulomb's Law and the Elementary Electric Charge<br>Sec. 1 to 7 incl.<br>Chapter 28 — Energy and Motion of Charges in Electric Fields<br>Sec. 1 to 7 incl.<br>Chapter 29 — Electric Circuits<br>Sec. 4 and 5<br>Chapter 30 — The Magnetic Field<br>Chapter 31 — Electromagnetic Induction and Electromagnetic Waves |
| **Experiments:**<br>IV — 1 to 10 | **Experiments:**<br>IV — 1, 2, 3, 4, (5*), (6*), 7, (8*), (9*), 10, 11, 12, 13<br>*Do not appear in 1st Edition |

**Notes to Teachers:**

1. Exhaustive treatment of Chapters 30, 31 is not necessary.
2. As much quantitative treatment should be attempted as the teacher considers advisable, in Chapters 30, 31.

## NOTES TO TEACHERS

1. See notes under PSSC Physics in the Science 20 program.
2. Further information regarding necessary laboratory equipment for offering PSSC Physics, is provided below.

## PSSC PHYSICS EQUIPMENT

Several companies now manufacture apparatus specifically designed for the PSSC course. Their catalogs list the apparatus in a very convenient form for ordering, but each company uses its own classification system so care must be exercised in translating from one list to another.

## CANADIAN SUPPLIERS ARE:

Canadian Laboratory Supplies (for Macalaster kits)

Central Scientific Co.

Stark Electronic Instruments Ltd., Ajax, Ontario

Welch Scientific Co.

The following list has been compiled from equipment available from each of these sources although exact names may vary slightly. Teachers will find the lists compiled by commercial outlets very useful in ordering equipment.

It is assumed that the following items are readily available locally: common pins, rubber bands, white paper, 2 inch nails, soft cardboard sheets, *1 qt. glycerine, corks, carbon paper, 15, 40 and 60 watt incandescent bulbs, rubber stoppers, black nylon thread, tracing paper, scotch tape, clothespins; mason's chalk line, modeling clay, aluminum foil, #18 insulated copper connecting wires, pliers, wire cutters, screwdrivers, sandpaper, paper towels.

## Equipment List for Physics 20 PSSC.

Equipment required for a class of 32 students using P.S.S.C. 1st or 2nd edition.

| | |
|---|---|
| 16 | C clamps 2" |
| 16 | C clamps 4" |
| 256 sheets | centimeter graph paper |
| 32 | double edge razor blades |
| 1 roll | aluminum foil wrap |
| 1 roll | saran wrap |
| 20 feet | No. 40 wire |
| 1 ream | white paper 8½ x 11 |
| 16 sheets | graph paper, log-log, 2 cycle |
| 16 sheets | cardboard, soft, 8½ x 11 |
| 32 | nails, 2" flat head |
| 1 box | pins, straight |
| 1 box | rubber bands, assorted |
| 1 lb. | modelling clay |
| 16 | florist pins, 3" or No. 22 wire |
| 16 sheets | graph paper, polar |
| 64 sheets | carbon paper |
| 100 feet | masking tape |
| 30 sheets | screen paper (approx. 2' x 2') or form from 8½ x 11" sheets of white paper |
| 32 | metal washers |
| 16 sheets | cardboard, 12" x 12" |
| 3 doz. | clothespins |
| 36 | paraffin blocks 2½" x 5" |
| 100 feet | insulated wire, flexible, single strand |
| 16 | protractors |
| 1 | tape measure (50 feet) (optional) |
| 8 | P.S.S.C. power supplies - 1.5, 6, 50, 100, 150, 200V dc |
| 16 | recording timers |
| 16 | stopwatches |
| 16 | stroboscope, hand |
| 16 | long-short distance apparatus |
| 16 | optics kits (1965 edition) for 2nd edition OR optics kit for 1st edition. |
| 16 | meter sticks |
| 16 | low power light sources |
| 16 | stoppers, cork, No. 2 or No. 4 |
| 500 feet | paper recording tape, ½" |
| 8 | wave demonstrator kits |
| 8 | high power light source |
| 8 | ripple tanks |

## Equipment List For PSSC Physics 30

Table I indicates equipment required for either the 1st edition or the 2nd edition. Table II is additional equipment for the 1st edition only and Table III additional equipment for the 2nd edition only. The equipment is for a class of 32 students.

### TABLE I

(Common for 1st and 2nd edition)

| | |
|---|---|
| 12 spools | thread, No. 15, 100 yds. per spool |
| 200 sheets | graph paper, centimeter divisions |
| 1 ream | onion skin paper |
| 1 package | carbon paper |
| 200 sheets | graph paper, translucent |
| 200 sheets | graph paper, polar |
| 500 feet | cord, white, glazed |
| 12 rolls | tape, cellulose, ¾" x 1296" |
| 50 | clothespins |
| 4 large rolls | masking tape |
| 1 roll | aluminum foil |
| 1 pkg. | nylon filament (102 yds) |
| 500 feet | wire, stranded, insulated, 20 gauge |
| 16 pieces | cardboard 8½" x 11" |
| 1 pkg | rubber bands, assorted sizes |
| 32 | bricks |
| 16 | protractor, plastic, 6" |
| 16 | helical steel spring kits |
| 2 | electrostatics class kits |
| 24 | beakers, 600 ml. |
| 8 | electroscopes |
| 32 | metal rods, 6" |
| 16 | ring stands, 36" |
| 16 | clamp holders |
| 32 | flask clamps |
| 1 tube | quick drying glue |
| 8 | high powered lamps with socket and cord |
| 8 | d.c. ammeter 0 to 5 amp. |
| 8 | horsecock, pinch clamps |
| 64 | clip leads, 2' |
| 32 | battery clips |

| | |
|---|---|
| 16 | rulers |
| 16 | weights (¼ lbs.) |
| 16 | 1½ volt timer |
| 1 pkg | recording tape, ½" x 500' |
| 32 | C Clamp 4" |
| 8 | balances, triple beam with extra range |
| 20 feet | rubber tubing, 3/8" |
| 24 pc. | glass tubing, 6 mm O.D. by 35 cm. |
| 1 lbs. | stoppers, rubber, No. 7, 2 hole |
| 8 | P.S.S.C. power supply, 200, 150, 100, 50, 6 and 1.5 V d.c. |
| 16 | wood bars, 1-¾" x 25/32" x 3' |
| 8 | dynamic cart kits |
| 8 | recording timer kits |
| 16 | meter sticks |
| 8 | inertial balance kits |
| 16 | stopwatches |
| 96 | C Clamp 2" |
| 8 | centripetal force kits |
| 16 | collision in two-dimension kits |
| 8 | dishes, (approx. 8" x 8" x 2") |
| 8 | electrodes, copper |
| 8 | flasks, boiling, 500 ml. |
| 8 | flasks, Erlenmeyer, 500 ml. |
| 24 | graduated cylinders, 100 ml. |
| 8 | rheostat, Vernier, 5 ohm/100 watt |
| 8 | flask, ring 7" |
| 16 | low power light source kit |
| 16 | tangent galvanometer |
| 16 sheets | sandpaper, fine |
| 16 | compass |
| 8 | air core solenoids |
| 16 | current balances |
| 16 | dowel sets |
| 16 | mass of the electron kits |
| 10 lbs. | sulfuric acid (conc.) |
| 8 | voltmeters range 0-6-10-200 V d.c. |
| 32 | clip leads, 4' |
| 8 | C Clamps, 6" |
| 32 | wedges, wood |

**TABLE II**

(1st edition only)

| | |
|---|---|
| 8 | dosimeter |
| 8 | dosimeter adapter kit |
| 8 | resistors, 1 meg ohm, ½ w |
| 8 | potential difference kit |
| 8 | cardboard carton, 18" x 18" x 18" |
| 8 | boards 1" x 1" x 12" |

**TABLE III**

(2nd edition only)

| | |
|---|---|
| 8 | Coulomb's law apparatus |
| 16 sheets | Masonite, 8" x 15" (optional) |
| 8 | Millikan apparatus |
| 8 | time and charge apparatus |
| 8 | milliammeter 0-1 ma |
| 16 | clamp, burette |
| 16 | clamp slides, resistance |

# SCIENCE II

**Text**

*Basic Science for Secondary Schools* by Hogg, et al

*Laboratory Manual to Accompany Basic Science for Secondary Schools*, Hogg et al

**References**

(i) *Explaining* the Sciences, Brandwein, et al

(ii) *Modern Biology*, Moon, Otto and Towle (1963 Edition)

NOTE: Students may use the text *Physical Science for Secondary Schools*, Hogg, Cross and Davis and *Supplement to Physical Science for Secondary Schools* in lieu of *Basic Science for Secondary Schools* Hogg et al.

**Course Content**

**UNIT I: The Earth As It Began**

1. The Earth — Its Origin (Optional)
2. Waters of the Earth
3. The Earth's Atmosphere

**UNIT II: Earth, The Abode of Man**

4. The Earth — Its Shape and Motion
5. Rocks of the Earth (1)
6. Rocks of the Earth (2)
7. The Changing Earth (Optional)
8. The Formation of Mountains
9. The Record of Rocks (Optional)
10. Earth History (Optional)

**UNIT III: Weather**

11. Winds and Air Masses
12. Fronts and Storms
13. Weather Forecasting (1)
14. Weather Forecasting (2) (Optional)
15. What is Climate?

**UNIT IV: Chemistry and Some Industries**

16. Oxygen and Hydrogen
17. Water, An Important Compound
18. A Chemist's Language and Shorthand
19. The Structure of the Atom (Optional)
20. Fuels: Solid, Liquid and Gaseous
21. Some Chemical Industries
22. Metals (Optional)
23. Foods, Drugs and Antiseptics

**UNIT V: Electricity**

24. Magnetism
25. Static Electricity
26. Current Electricity
27. Heat and Light from Electricity
28. Power from Electricity

**UNIT VI: Communication** (Optional)

29. What is Sound?
30. Sound Instruments
31. The Telephone and Some Electronic Devices
32. Radio and Television (Optional)

**UNIT VII: Atoms and Stars**

33. Power from Atoms
34. The Sun
35. The Solar System
36. Stars and Galaxies

**UNIT VIII: Biology — The Study of Life**

37. The Living Cell
38. The Classification of Plants and Animals
39. Plants
40. Animals
41. Heredity — Transmission of Characteristics

**Experiments**

Experimental work to be done includes those experiments listed in the laboratory manual. However, experiments 5, 18 and 19 should be considered as optional.

NOTES: Teachers should feel free to excercise considerable freedom in the development of this course. They may wish to give little prominence to certain units and deal with other units in greater depth. Teachers may also wish to give less time and attention to some sections of the course in order to have time to pursue those sections regarded as optional.

Experimentation in this course may serve a number of purposes such as student motivation, exploration of the new ideas and concepts as well as verification of data already known.

Apparatus and materials to be used in the experimental phase of this course will be found in any well-equipped physical and biological science laboratory.

# SCIENCE 22

Science 22 is designed for students in vocational high schools who are taking programs which articulate with the Institutes of Technology e.g. Drafting, Electronics, Machine Shop. It is expected that students in other programs may elect this course. Teachers should feel free to adjust the content and method of presentation to the capabilities of their classes; however, it is felt that students in the articulated programs should substantially cover the program as outlined:

## A. PHYSICS SECTION —

**Text** *(Physics an Exact Science, White)*

1. Introduction
   Lessons 3, 4*
2. Properties of Matter
   Lessons 4, 5*, 6, 7*
3. Light
   Lessons 1, 2, 3*, 4, 5*, 6, 7, 8*, 9, 10*, 11, 12, 13*, 14, 15*

### Laboratory Exercises

The lessons above which are indicated by an asterisk are laboratory experiments found in a separate laboratory manual which accompanies the text. Students and teachers will require: *Laboratory Exercises* to accompany *Physics an Exact Science,* White

## B. CHEMISTRY SECTION (4 MONTHS)

**Text** — *Chemistry for Secondary Schools,* Advanced Edition, Croal et al

1. Chapters 10 - 16 inclusive — Gas Laws, Laws and Theories, Symbols, Formulae, Equations, Valence, Naming Compounds, Using Equations, Ionization.
2. Chapters 21 - 23 inclusive — Periodic Classification of Elements, The Halogens, The Alkali Metals.
3. Laboratory activities for the chemistry section can be found in *Experiments in Laboratory Chemistry* by Couke, Croal, Louden. Some activities can be carried out as demonstrations in keeping with the teaching technique desired.

Teachers of Science 22 should give proper and sufficient emphasis to problem solving and laboratory activity. "Britannica Films" are a useful aid for lessons in the physics section. Sound motion picture films of thirty minutes each are available for use in conjunction with any or all lessons in the physics section. It is expected that teachers will adjust the content and method of presentation in each section to the capabilities of the pupils.

# PHYSICS 32

As for Science 22, Physics 32 is designed for students in vocational high schools who are taking programs which articulate with the Institute of Technology and is expected to be equivalent to the Year "A" Physics program in the technical institutes. Information on course content and laboratory exercises follows.

### Text

*Physics, An Exact Science, White*

### Course Content

1. Light - Lessons 1, 2, 3*, 4, 5*, 6, 7, 8*, 9, 10*, 11, 12, 13*, 14, 15*.
2. Electricity and Magnetism
   Lessons 1, 2, 3, 4*, 5, 6*, 7, 8, 9*, 10, 11*, 12, 13, 14*, 15, 16*, 17, 18, 19*, 20, 21*, 22, 23, 24*.
3. Atomic Physics - Lessons 1, 2, 3, 4*, 5, 6*, 7, 8, 9*.
4. Electronics (Optional) - Lessons 1, 2, 3*.

Laboratory Work

Some of the lessons which make up the course content are marked with an asterisk. These are laboratory experiments found in a separate laboratory manual which accompanies the text. Students and teachers will require this laboratory manual which has the title,
*Laboratory Exercises* to accompany *Physics An Exact Science.* White.

In Physics 32, teachers should give proper and sufficient emphasis to problem solving and laboratory activity. "Britannica Films" of thirty minutes each are available for use in conjunction with any or all lessons.

Course Content

### Mechanics

Lessons 1, 2*, 3, 4*, 5, 6, 7, 8*, 9, 10, 11*, 12, 13*, 14, 15, 16*, 17, 18*, 19, 21, 23, 24, 27, 29, 30*, 31, 32, 33*.

### Electricity

Lessons 1, 2, 3, 4*, 5, 6*, 7, 9.

### Heat

Lessons 1, 3, 7*, 8, 9, 11, 12*.

# REFERENCES

## BOOKS


*Chemical Bonding* — Companion, (McGraw-Hill)

*The Chemical Elements* — (Science Service, 1719 N Street, N.W., Washington 6, D.C.

*Classroom Aids for Teachers* — (Department of Education)

*A New Dictionary of Chemistry* — Miall and Miall. Brief explanation of terms used in chemistry and chemical engineering. (Longmans Canada Limited, 137 Bond Street, Toronto 2, Ontario.)

*Dictionary of Physics* — J. Gray. Covers all branches of Physics. (Longmans Canada Limited, 137 Bond Street, Toronto 2, Ontario.)

*Great Experiments in Physics* — Shamos, (Holt, Rinehart & Winston)

*History of Science Cases for High School* — Klopfer, (Science Research Associates)

*Illustrated Encyclopedia of Modern Sciences, 1959* — (Thomas Allen Ltd., 266 King Street West, Toronto 2B, Ont.)

*Introductory Physical Science* (students) — Physical Science Study Committee of Education Services Incorporated of Watertown Mass. (Distributor: Prentice Hall Inc. Englewood Cliffs, New Jersey.)

*On Understanding Science*, — J. B. Conant, (Yale University Press, New Haven, Conn.)

*Physical Education* — (Institute of Physics and the Physics Society 41 Belgrave Square, London S.W.1.)

*School Facilities for Science Instruction* — Richardson, (National Science Teachers Association).

*Science and Ideas* — Arons and Bork, (Prentice-Hall)

*Your Science Fair* — Welte, Dimond, Friedl. (Burgess Publishing Company 426 South 6th Street, Minneapolis 15, Minnesota.)

*Taxonomy of Education Objectives* — B. S. Bloom, (David McKay Co. Inc., 119 West 40th St., New York 18, New York.)

*Teaching Chemistry with Models* — Sanderson, (Van Nostrand)

*Teaching High School Science: A Sourcebook for the Biological Sciences* — Moreholt, Brandwien, Joseph (W. J. Gage Limited, 1500 Birchmount Road, Box 550, Scarborough, Ontario.)

*Teaching High School Science: A Sourcebook for the Physical Sciences* — Moreholt, Brandwien, Joseph (W. J. Gage Limited, 1500 Birchmount Road, Box 550, Scarborough, Ontario.)

*Teaching Science in Today's Secondary Schools* — Thurber & Collette, (Allyn & Bacon)

*Teaching the Pursuit of Science* — Woodburn and Obourn. (Macmillan)

*The Teaching of Physics* — Warren, (Butterworths)

*The Teaching of Science as Inquiry* — J. J. Schwab, (Harvard University Press, Cambridge Mass.)

*Understanding Science: Teaching and Testing* — Wedelsky, (Harcourt, Brace & World)

*Why Do Chemical Reactions Occur?* — Campbell, (Prentice-Hall)

## PERIODICALS

*C.I.L. Oval, Monsanto, Imperial Oil Review*

*Endeavour* — A British quarterly scientific journal. No charge is made for "Endeavour". Imperial Chemical Industries Limited, Millbank, London S.W. 1.

*Journal of Chemical Education* — 20th and Northampton Streets, Easton, Penn.

*The Physics Teacher* — 1201 - 16 Street, N.E. Washington, D.C., U.S.A.

*SCAT Bulletin* — 11010 - 142 Street, Edmonton, Alberta (obtained free with membership in the Science Council A.T.A.)

*School Science and Mathematics* — Central Association of Science and Mathematics Teachers( Inc., P.O. Box 408 Oak Park, ILL.

*The School Science Review* — Association for Science Education, 52 Bateman Street, Cambridge, England.

Teachers' and students' periodical.

*Science News* — Published eight times during the school year by Science Publications of Canada. Subscriptions and business correspondence should be addressed to 25 Hollinger Road, Toronto 16, Ontario.

*Science News* — A leaflet which gives articles and news of interest to science teachers. Free, A & B Science News Allyn and Bacon, Inc., 150 Tremont St., Boston 11, Massachusetts.

*Science News Letter* — A weekly summary of current science, published every Saturday by Science News, Inc., 1719 N Street, N.E., Washington 6, D.C.

*The Science Teacher* — Journal of the National Science Teachers' Association. Published monthly by the Association at 1201 Sixteenth Street, N.W. Washington 6, D.C.

*Science World* — 33 West 42nd St., New York 36, New York

*Scientific American* — 415 Madison Avenue, New York 17, New York, U.S.A.

*Tomorrow's Scientists* — Is published four times a year for science students. Published by the National Science Teachers' Association, 1201 Sixteenth St., N.W., Washington 6, D.C.

## ADDITIONAL SCIENCE MATERIALS

*Chemistry Recordings* — Order from Audio Educational Aid, Department 53, Box 250, Butler, Missouri, The records are 33 1/3 r.p.m.

*The Elemental Slyd-Rul* — Tells you at a glance, symbol, weight, density, number, valences, color, melting and boiling point in C for the 98 elements. The Slyd-Rul Company, Canaan, New York.

*Experiment-of-the-month-Club* — Experiment-of-the-Month Club, P.O. Box 325, Danbury, Conn.

*The Science Materials Center* — Send for catalog and price list from: Science Materials Center, 59 Fourth Avenue New York 3, New York.

*Things of Science* — Science Service, 1719 N Street, N.W., Washington 6, D.C.

## DEMONSTRATION EQUIPMENT

*Atom Model* — School, Catalog No. 302-88 - La Pine Scientia Company, 6001 South Knox Avenue, Chicago 29, Illinois U.S.A.

*Molecular Model Kit S8400* — Canadian Laboratory Supplies, 10989 - 124 Street, Edmonton, Alberta.

*Molecular Model Kits* — Student Molecular Model U 40, O. H. Johns Glass Company Limited, 219 Broadview Avenue Toronto, Ontario.

## USEFUL BOOKLETS AND LEAFLETS

*Science Experiences with Inexpensive Equipment* — D. J. Lyne, (Van Nostrand Co. Ltd., 25 Hollinger Road, Toronto 16, Ontario.)

*Science Experiences with Home Equipment* — C. J. Lyne, (Van Nostrand Co. Ltd., 25 Hollinger Road, Toronto 16 Ontario.)

*Science Model Making* — R. R. Hopwood, (Longmans Canada Limited, 137 Bond Street, Toronto 2, Ontario.)

*Science Experiences with Ten-Cent Store Equipment* — C. J. Lyne, (Van Nostrand Co., 25 Hollinger Road, Toronto 16, Ontario.)

*Successful Devices in Teaching Chemistry* — Paul Westmeyer, J. Weston Walch, (Box 1075, Portland, Maine.)

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HIGH SCHOOL SCIENCE
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